

Classification of environmental conditions —

**Part 4-6: Guidance for the correlation
and transformation of environmental
condition classes of IEC 60721-3 to the
environmental tests of IEC 60068 —
Ship environment**

ICS 19.040; 19.080; 47.020.01

National foreword

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Classification des conditions d'environnement –

Partie 4-6:

**Guide pour la corrélation et la transformation
des classes de conditions d'environnement
de la CEI 60721-3 en essais d'environnement
de la CEI 60068 –
Environnement des navires**

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Part 4-6:

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of environmental condition classes of IEC 60721-3
to the environmental tests of IEC 60068 –
Ship environment**



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CONTENTS

FOREWORD	3
INTRODUCTION	5
1 Scope and object	6
2 Reference documents	6
3 Overview	7
3.1 General remarks concerning IEC 60721	7
3.2 General remarks concerning IEC 60068	7
3.3 Severities	8
3.4 Recommended tests	8
3.5 Environmental tests for ship environment	8
3.6 Test durations	8
3.7 Ambient	8
4 Climatic conditions	9
5 Dynamic conditions	17
Annex A – Ship environment — Climatic conditions	23
Annex B – Ship environment — Dynamic conditions	37
Table 1 – Recommended tests for IEC 60721-3-6 – Class 6K1	9
Table 2 – Recommended tests for IEC 60721-3-6 – Class 6K4	11
Table 3 – Recommended tests for IEC 60721-3-6 – Class 6K5	14
Table 4 – Recommended tests for IEC 60721-3-6 – Class 6M2	17
Table 5 – Recommended tests for IEC 60721-3-6 – Class 6M3	19
Table 6 – Recommended tests for IEC 60721-3-6 – Class 6M4	21
Table A.1 – Recommended tests for IEC 60721-3-6 – Class 6K2	23
Table A.2 – Recommended tests for IEC 60721-3-6 – Class 6K3	25
Table A.3 – Recommended tests for IEC 60721-3-6 – Class 6K6	29
Table A.4 – Recommended tests for IEC 60721-3-6 – Class 6K7	33
Table B.1 – Recommended tests for IEC 60721-3-6 – Class 6M1	37

INTERNATIONAL ELECTROTECHNICAL COMMISSION

CLASSIFICATION OF ENVIRONMENTAL CONDITIONS –

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of environmental condition classes of IEC 60721-3
to the environmental tests of IEC 60068 –
Ship environment**

FOREWORD

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IEC 60721-4-6, which is a technical report, has been prepared by IEC technical committee 104: Environmental conditions, classification and methods of test.

The text of this technical report is based on the following documents:

Enquiry draft	Report on voting
104/62/CDV	104/112/RVC

Full information on the voting for the approval of this technical report can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 3.

The committee has decided that the contents of this publication will remain unchanged until 2002.
At this date, the publication will be

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

This document which is purely informative is not to be regarded as an International Standard.

INTRODUCTION

It is essential to emphasise the guidance nature of this report since it is virtually impossible to specify mandatory requirements for worldwide use. However, for those cases which require different tests from those recommended in this report, the guidance given should establish principles and methodology to determine alternative tests.

Transformation guidance is provided where the parameters used to define conditions in IEC 60721-3-6 are different from those used to define the tests and/or the severities in IEC 60068-2.

The reasons for correlation are provided to enable specification writers to modify a test if their application warrants it. Where differences in values of parameters exist between IEC 60721-3-6 and IEC 60068-2, the nearest severities of the IEC 60068-2 test procedures are used. If it is necessary to deviate from an IEC 60068-2 severity, the reasons are detailed in the report and an alternative test is recommended in the tables.

CLASSIFICATION OF ENVIRONMENTAL CONDITIONS –

Part 4-6: Guidance for the correlation and transformation of environmental condition classes of IEC 60721-3 to the environmental tests of IEC 60068 – Ship environment

1 Scope and object

This part of IEC 60721 is a technical report dealing with the correlation and transformation of the conditions given in IEC 60721-3-6 to the environmental tests defined in IEC 60068-2.

An environment may consist of a number of environmental conditions such as dynamic, climatic and biological and other effects due to chemically and mechanically active substances. In this report, only dynamic and climatic conditions have been considered.

The purpose of this technical report is to provide the specification writer with guidance, together with a set of easy-to-use tables which correlate and transform these conditions.

2 Reference documents

IEC 60068-1:1988, *Environmental testing – Part 1: General and guidance*

IEC 60068-2-1:1990, *Environmental testing – Part 2: Tests – Tests A: Cold*

IEC 60068-2-2:1974, *Environmental testing – Part 2: Tests – Tests B: Dry heat*

IEC 60068-2-5:1975, *Environmental testing – Part 2: Tests – Test Sa: Simulated solar radiation at ground level*

IEC 60068-2-6:1995, *Environmental testing – Part 2: Tests – Test Fc: Vibration (sinusoidal)*

IEC 60068-2-7:1983, *Environmental testing – Part 2: Tests – Test Ga: Acceleration, steady state*

IEC 60068-2-9:1975, *Environmental testing – Part 2: Tests – Guidance for solar radiation testing*

IEC 60068-2-13:1983, *Environmental testing – Part 2: Tests – Test M: Low air pressure*

IEC 60068-2-14:1984, *Environmental testing – Part 2: Tests – Test N: Change of temperature*

IEC 60068-2-18:1989, *Environmental testing – Part 2: Tests – Test R and guidance: Water*

IEC 60068-2-27:1987, *Environmental testing – Part 2: Tests – Test Ea and guidance: Shock*

IEC 60068-2-29:1987, *Environmental testing – Part 2: Tests – Test Eb and guidance: Bump*

IEC 60068-2-30:1980, *Environmental testing – Part 2: Tests – Test Db and guidance: Damp heat, cyclic (12 + 12 hour cycle)*

IEC 60068-2-52:1996, *Environmental testing – Part 2: Tests – Test Kb: Salt mist, cyclic (sodium chloride solution)*

IEC 60068-2-56:1988, *Environmental testing – Part 2: Tests – Test Cb: Damp heat, steady state, primarily for equipment*

IEC 60721-2-3:1987, *Classification of environmental conditions – Part 2: Environmental conditions appearing in nature – Air pressure*

IEC 60721-2-4:1987, *Classification of environmental conditions – Part 2: Environmental conditions appearing in nature – Solar radiation and temperature*

IEC 60721-2-6:1990, *Classification of environmental conditions – Part 2: Environmental conditions appearing in nature – Earthquake vibration and shock*

IEC 60721-3-6:1987, *Classification of environmental conditions – Part 3: Classification of groups of environmental parameters and their severities – Ship environment*

IEC 60721-4-0, *Classification of environmental conditions – Part 4-0: Guidance for the correlation and transformation of the environmental condition classes of IEC 60721-3 to the environmental tests of IEC 60068 – Introduction¹⁾*

ISO 554:1976, *Standard atmospheres for conditioning and/or testing – Specifications*

ISO 2533:1975, *Standard atmosphere – Addendum 1 (1985), Addendum 2 (1997)*

3 Overview

3.1 General remarks concerning IEC 60721

IEC 60721-3-6 establishes classes of groups of environmental parameters with their associated environmental conditions to which products may be exposed during transportation. Parameters in these classes are given individually, but the products may be exposed to them simultaneously. Some of the parameters are independent whilst others may be strongly, correlated, for example, solar radiation and temperature.

3.2 General remarks concerning IEC 60068

IEC 60068-2 establishes a series of environmental test procedures and appropriate test severities. Selection of test severities depends upon the failure consequences of the product. Two types of product may be placed at locations covered by the same environmental class. However, one type of product may be tested under significantly more severe conditions than the other because of its different failure consequences. This report only addresses normal failure consequences; for higher failure consequences, the test severity may need to be increased on the basis of specialist knowledge of the product.

¹⁾ To be published.

3.3 Severities

IEC 60721-3-6 establishes classes of environmental conditions, having a low probability of being exceeded, which cover the extreme short-term conditions to which products may be exposed. The suggested test severities given in the tables of this report standard take this into account. For further information, refer to IEC 60721-4-0 which serves as an introduction to the IEC 60721-4 series.

3.4 Recommended tests

In the following tables, two types of test are shown. The first details the equivalent IEC 60068-2 test using the nearest recommended severities. The second is the recommended test method and severities, which are considered to be more suitable for testing most electrotechnical products.

3.5 Environmental tests for ship environment

The ship environment classes specify the environmental conditions to which a product is exposed under its conditions of use when installed aboard ships. Environmental conditions created by co-located products within an enclosure are not included in these classes.

The relevant specification should specify when, during the environmental test programme, the product is in its operational state, and which performance requirements should be measured before, during and after the test, together with the failure criteria.

3.6 Test durations

The durations recommended in tables 1 to 6 are selected on the basis that experience has shown them to be sufficient to demonstrate the effect of the condition on most products. However, the user may change these values if experience of a specific application warrants it. To assist the user, the notes associated with the tables in this report explain why the recommended duration was chosen.

3.7 Ambient

The term "ambient" which is used for some recommended tests refers to the standard atmospheric conditions described in 5.3.1 of IEC 60068-1; that is, between 15 °C and 35 °C and from 25 % to 75 % RH with a maximum absolute humidity of 22 g/m³ and at air pressure between 86 kPa and 106 kPa. Details of the standard atmospheric conditions are provided in ISO 2533 and its addenda, whilst a summary is provided in IEC 60721-2-3. A "reference condition" for testing is described in ISO 554.

4 Climatic conditions

Table 1 – Recommended tests for IEC 60721-3-6 – Class 6K1

(totally weatherprotected, heated and ventilated locations)

IEC 60721-3-6 – Climatic conditions		IEC 60068-2 – Climatic tests				
Environmental parameter ^a	Class 6K1	Nearest IEC 60068-2		Recommended test		Note No.
		Test method	Severity	Test method	Severity	
a) Low air temperature, air	+5 °C	As recommended test		60068-2-1: Ab/Ad	+5 °C, 16 h	1)
b) Low air temperature, water:freezing point of water		No IEC 60068-2 test		Test normally not required – See note 2)		2)
c) High temperature, air	+40 °C	As recommended test		60068-2-2: Bb/Bd	+40 °C, 16 h	3)
d) High temperature, surfaces	No					
e) High temperature, water	+30 °C	No IEC 60068-2 test		Test normally not required – See note 4)		4)
f) Gradual change of temperature, air/air	No					
g) Change of temperature, air/water	No					
h) Relative humidity, not combined with rapid temperature changes	95 % +30 °C	As recommended test		60068-2-56: Cb	+30 °C, 93 % RH, 10 days	5)
i) Relative humidity, combined with rapid temperature changes: air/air at high relative humidities	No					
j) Relative humidity, combined with rapid temperature changes: air/air at high water contents	No					
k) Low relative humidity	10 % +30 °C	No IEC 60068-2 test		Test normally not required – See note 6)		6)
l) Movement of surrounding medium, air	Negligible					
m) Precipitation, rain	No					
n) Solar radiation	Negligible					
o) Radiation: heat,	Negligible					
p) Water from sources other than rain	No					
q) Wetness	No					
^a No climatograms are shown for the climatic classes since they are not included in IEC 60721-3-6.						
NOTE "No" in the class column means that no IEC 60721-3-6 condition is specified.						

Explanatory notes for table 1 – Class 6K1

- 1) The environmental condition and test severity are the same, and therefore no detailed explanation of the choice is necessary; however, the effects of solar irradiation should also be taken into account (see note 14) of table 2. The choice of the duration of 16 h is considered to be sufficient for most heat-dissipating specimens to demonstrate that their design is adequately tolerated to function at this temperature.
- 2) No suitable IEC 60068-2 test exists. For products which may be influenced by the formation of sea ice, a sequence test of IEC 60068-2-18 Rb method 2.2 followed by IEC 60068-2-1 Ab/Ad in table 1 should be considered. An example of such is where the ice can form in joints or narrow places in the structure, causing mechanical and insulation faults, cracking and leaking. The user should, however, note that this test cannot replicate the actual ice mass which is likely to be experienced in this class.
- 3) The environmental condition and test severity are the same, and therefore no detailed explanation of the choice is necessary. The choice of the duration of 16 h is considered to be sufficient for most heat-dissipating specimens to demonstrate that their design is adequately tolerated to function at this temperature.
- 4) No suitable IEC 60068-2 test exists. This condition should be taken into account when selecting material for the product.
- 5) The nearest preferred test severity of the damp heat steady-state test has been chosen, although the relative humidity is slightly lower than the value of the characteristic severity. The choice of the duration of 10 days is considered to be sufficient for most heat-dissipating specimens to demonstrate that their design is adequately tolerated to function at this condition.
- 6) No suitable test is available in the IEC 60068-2 series. The main effect of low relative humidity are embrittlement, shrinking, impairment of mechanical strength, increase in wearing of contact surfaces and developing of electrostatic charge. Typical faults caused by drying are mechanical faults of non-metallic parts, cracking and electrical faults. Low relative humidity may attract dust particles, which cause, for example, wearing of contact surfaces. These effects have to be considered when selecting materials and components for products for this class.

Table 2 – Recommended tests for IEC 60721-3-6 – Class 6K4
(non-ventilated locations with solar radiation, rain and water jets)

IEC 60721-3-6 – Climatic conditions		IEC 60068-2 – Climatic tests				
Environmental parameter ^a	Class 6K4	Nearest IEC 60068-2		Recommended test		Note No.
		Test method	Severity	Test method	Severity	
a) Low air temperature, air	–25 °C	As recommended test		60068-2-1: Ab/Ad	–25 °C, 16 h	1)
b) Low air temperature, water: freezing point of water		No IEC 60068-2 test		Test normally not required – See note 2)		2)
c) High temperature, air	+70 °C	As recommended test		60068-2-2: Bb/Bd	+70 °C, 16 h	3)
d) High temperature, surfaces	+70 °C	No IEC 60068-2 test		Test normally not required – See note 4)		4)
e) High temperature, water	+35 °C	No IEC 60068-2 test		Test normally not required – See note 5)		5)
f) Gradual change of temperature, air/air	–25 °C +40 °C 3 °C/min	As recommended test		60068-2-14: Nb	–25 °C to +40 °C Rate: 3 °C/min, two cycles	6)
g) Change of temperature, air/water	+40 °C +5 °C	No IEC 60068-2 test		Test normally not required – See note 7)		7)
h) Relative humidity, not combined with rapid temperature changes	95 % +45 °C	As recommended test		60068-2-56: Cb	+40 °C, 93 % RH, 10 days	8)
i) Relative humidity, combined with rapid temperature changes: air/air at high relative humidities	95 % –25 °C +35 °C	As recommended test		Steady-state humidity test (Test Cb) followed immediately by the rapid change of temperature test (Test Na).		9)
j) Absolute humidity, combined with rapid temperature changes: air/air at high water contents	60 g/m ² +70 °C +15 °C	As recommended test		60068-2-30: Db Variant 2	+55 °C, 90 % to 100 % RH Two cycles	10)
k) Low relative humidity	10 % +30 °C	No IEC 60068-2 test		Test normally not required – See note 11)		11)
l) Movement of surrounding medium, air	30 m/s	No IEC 60068-2 test		Test normally not required – See note 12)		12)
m) Precipitation, rain	6 mm/min	As recommended test		60068-2-18: Rb Method 2.2	Exposure: 6 min/mm ² Duration: 30 min minimum	13)
n) Solar radiation	1 120 W/m ²	60068-2-5: Sa Procedure C	1 120 W/m ² three cycles, 40 °C	Add 15 °C to the dry heat test and evaluate materials for photochemical reactions		14)
o) Radiation: heat,	1 200 W/m ²	No IEC 60068-2 test		Test normally not required – See note 15)		15)
p) Water from sources other than rain	3 m/s	No IEC 60068-2 test		60068-2-18: Ra/Rb	See note 16)	16)
q) Wetness: wet surfaces		No IEC 60068-2 test		Test normally not required – See note 17)		17)

^a No climatograms are shown for the climatic classes since they are not included in IEC 60721-3-6.

^a No climatograms are shown for the climatic classes since they are not included in IEC 60721-3-6.